The M221 Logic Controller

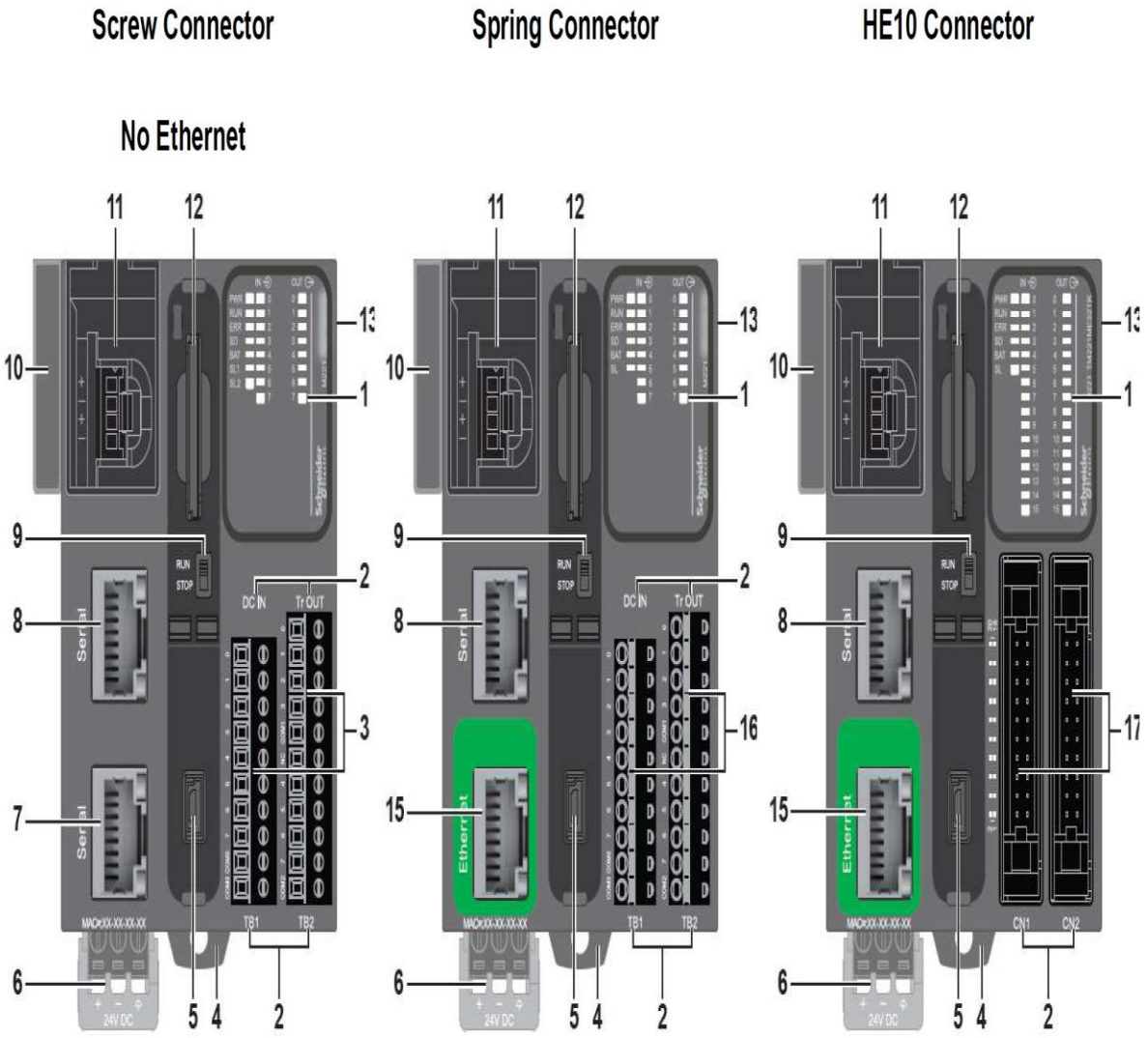
Capabilities

- Small size - 70mm with 32 I/O
- 5K instructions per millisecond
- High speed counters and pulse output
- SD card for data transfer
- On-line modification
- Real Time Clock
- csv export/import of object names and descriptions
- Program via USB or Ethernet (where fitted)
- Serial port for Modbus or ASCII communication
- Two built-in analog inputs

Features of the M221

The appearance of the M221 Logic Controller will depend on the connector type and whether it has an Ethernet port. Three of the configurations are shown below

1	System LEDs	10	Analog input cover
2	I/O label information	11	2 analog inputs
3	I/O removable screw terminals	12	SD card port
4	Clip lock for 35mm DIN rail	13	TM3 bus connector
5	USB mini-B programming port	14	Plastic cover
6	24V DC power supply	15	Ethernet port
7	Serial line port 2	16	I/O removable spring terminals
8	Serial line port 1	17	I/O HE10 terminals
9	Run/Stop switch		



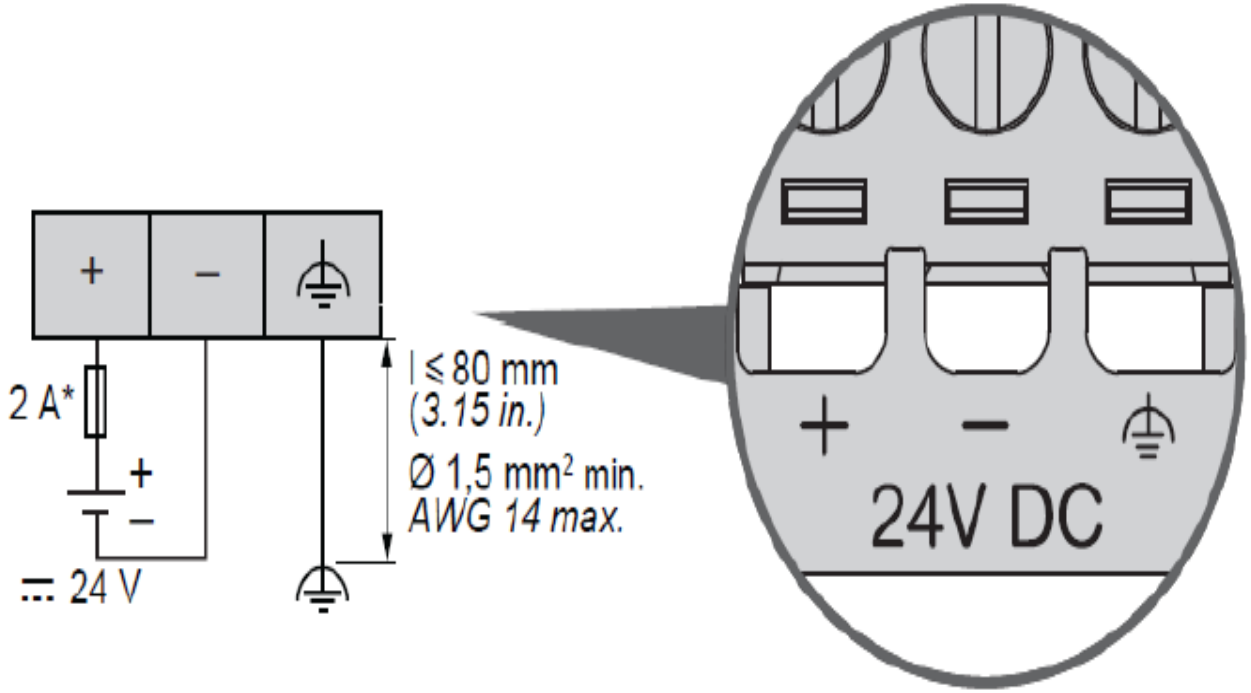
Product Code

- ✓ The first five characters of the part number (TM221) define that it is a M221 Logic Controller
- ✓ The next character defines whether the controller is a M221 logic controller (C) or a M221 book controller (M)
- ✓ If this is followed by the letter 'E' the controller is fitted with an Ethernet port
- ✓ The next two numbers define the total amount of digital I/O.
- ✓ The next character defines whether the outputs are (R) relay or (T) transistor
- ✓ For book controllers a **G on the end indicates spring I/O connectors** instead of screw connectors
- ✓ For book controllers a **K on the end indicates HE10 connectors** which must be used with the high density 32 I/O units due to space limitations.

M221 Wiring

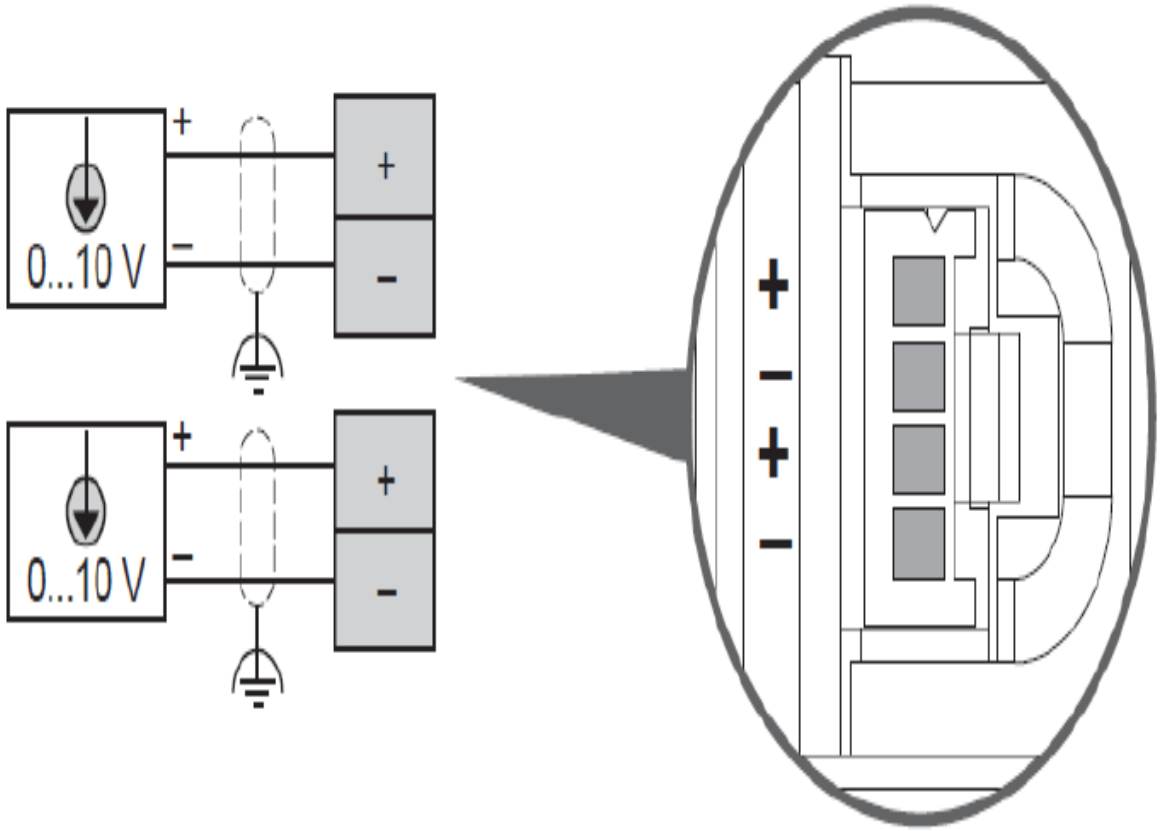
Power Supply

M221 logic controllers can be powered using 24VDC or 100-240VAC. All M221 book controllers are powered by 24V DC. The connector is on the bottom of the unit.



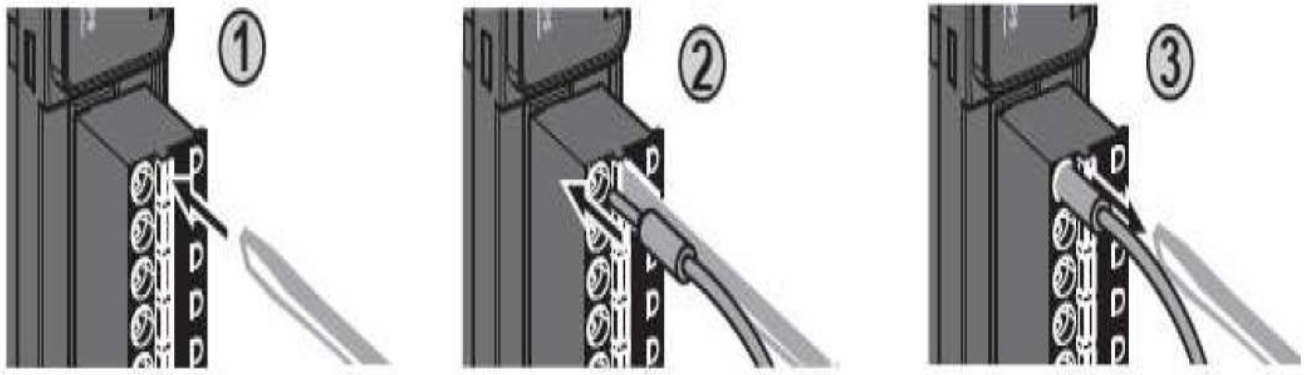
Analog Inputs

All M221 controllers have two independent 0-10V analog inputs. These are located under the cover at the top left of the unit (it has the QR code on it). The wiring is as shown.



I/O Connectors

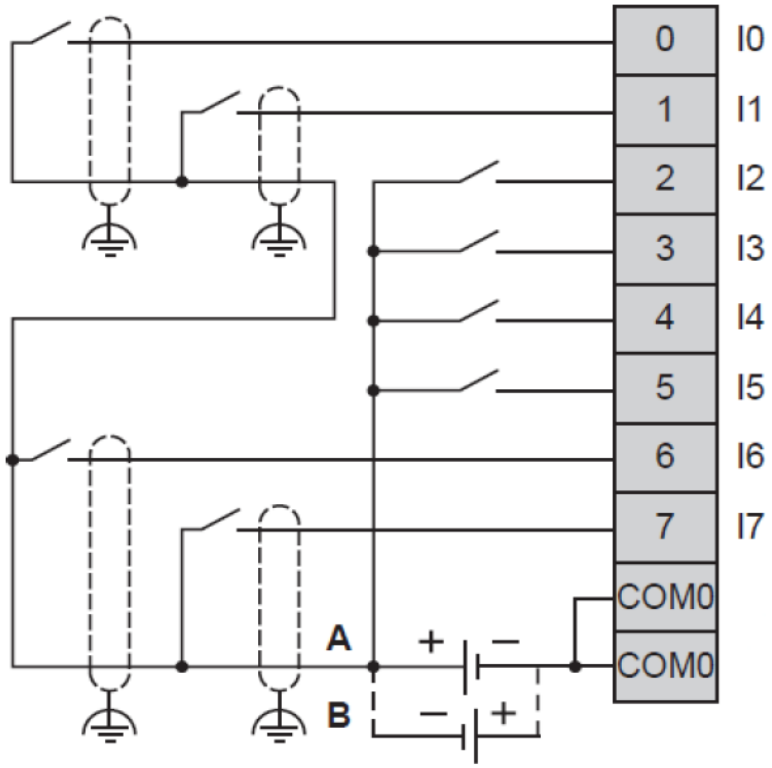
There are three types of connector for the M221 Logic controller I/O. Screw terminals allow each wire to be fitted and a screw will hold the wire in place. Spring terminals allow the wires to be more easily inserted or extracted.

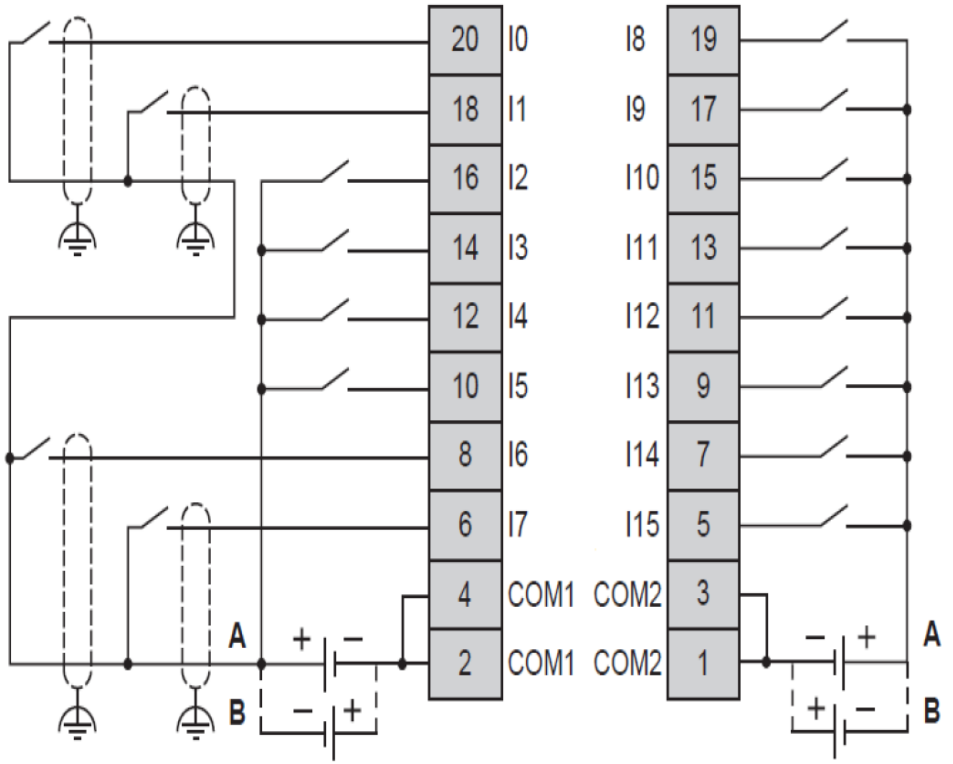


HE10 connectors are a standard connection for Schneider PLCs and controllers. They allow high density connection so are ideal for the 32 I/O version of the M221. This connector does require a special cable and different types are available – see the catalog for details of part numbers. In all cases, the terminal block can be unplugged, allowing the wiring to be easily removed from the M221.

Input Wiring

The wiring for the 8 and 16 input versions of the M221 Logic Controller are shown below.

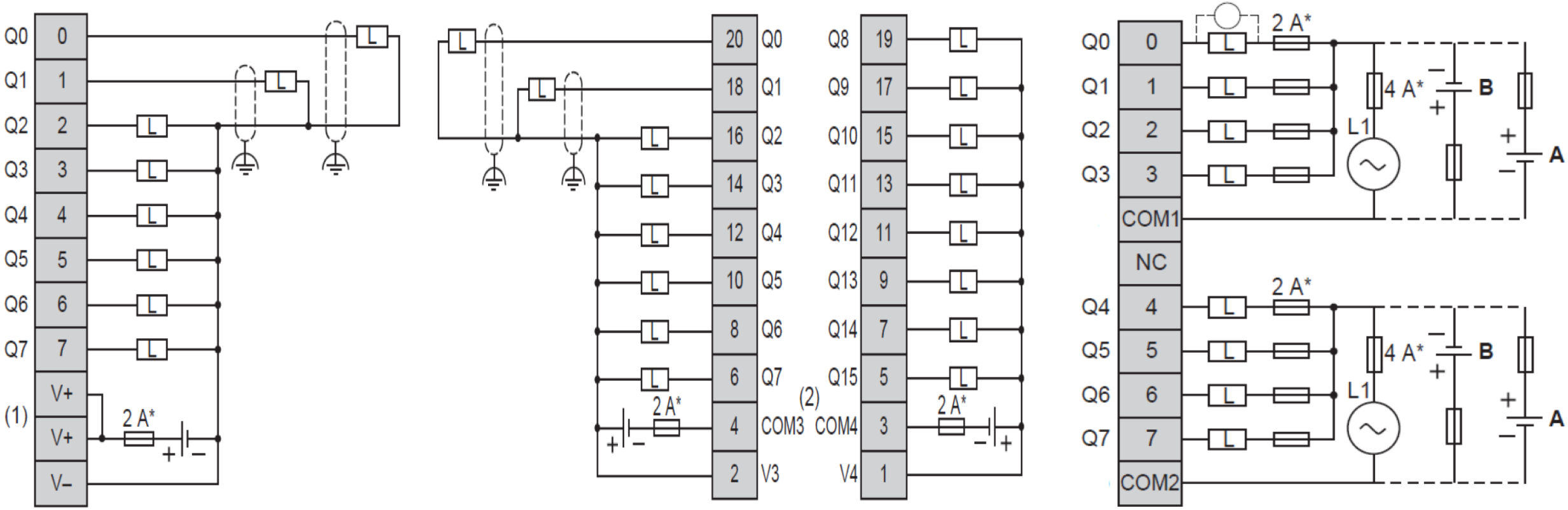




The first two inputs are shown shielded as they can be used for high speed pulse inputs so should be protected from noise. If these are used as normal outputs, they need not be shielded.

Output Wiring

The wiring for the 8 and 16 output versions of the M221 Logic Controller are shown below

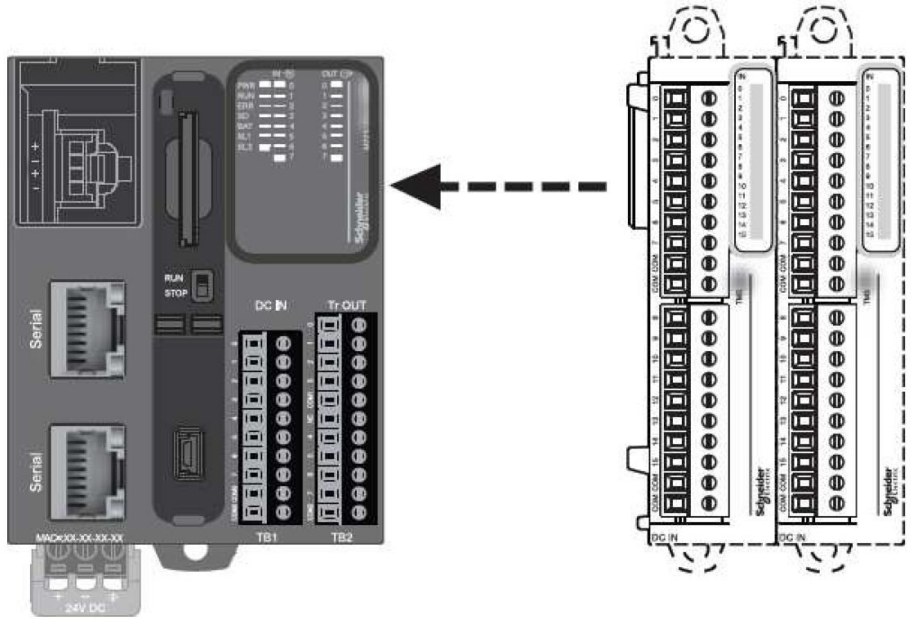


The first two outputs are shown shielded as they can be used for high speed pulse outputs so should be protected from noise. If these are used as normal outputs, they need not be shielded. For the relay output version of the M221, the outputs need not be shielded as they cannot be used for high speed pulse output.

Expansion

I/O Modules

I/O modules can be added to the M221 controller to expand its capabilities.



There are two types of module that can be added. TM2 modules are existing modules for Twido that can be used and allow the M221 to be compatible with Twido applications. This makes upgrading from the Twido to M221 simple especially when coupled with the Twido to M221 application conversion that is part of the SoMachine Basic software. TM3 modules are a new range specifically designed for the M2xx range of Logic Controllers to take advantage of the extended I/O expansion bus. They offer new capabilities that are not available to the Twido.

I/O Modules

- ✓ **TM2 Digital Modules**
  - TM2 Digital modules offer a range of I/O configurations with 8, 16 or 32 inputs, 8, 16 or 32 outputs and a mixture of input and outputs.
  - As with the M221, the outputs can be either transistor or relay.
  - They come with removable screw, spring contact or MIL connectors, the last of which is used for the high density 32 I/O modules.
  - These modules are compatible with the Twido controller.

- ✓ **TM2 Analog Modules**
  - TM2 Analog modules offer a range of I/O configurations with 2, 4 or 8 inputs, 1 or 2 outputs and a mixture of input and outputs.
  - The inputs are designed for a range of field devices including thermocouples, NTC probes and PT100/PT1000. The outputs are configurable for either 0-10V DC or 4-20mA.
  - All come with removable screw terminal blocks except the PT100/PT1000 modules which are fitted with a RJ11 connector.
  - These modules are compatible with the Twido controller.

- ✓ **TM3 Digital Modules**
  - TM3 Digital modules offer a range of I/O configurations with 8, 16 or 32 inputs, 8, 16 or 32 outputs and a mixture of input and outputs. As with the M221, the outputs can be either transistor or relay.
  - They come with removable screw or HE10 connector which are either an option on the 16 I/O modules or required for the high density 32 I/O modules.

I/O Modules

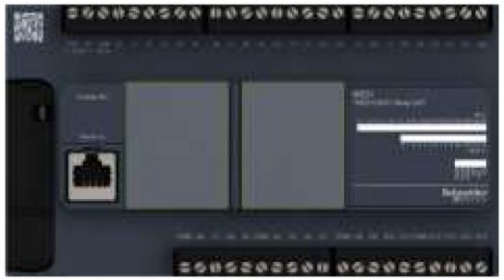
- ✓ **TM3 Analog Modules**
  - TM3 Analog modules offer a range of analog inputs and outputs.
  - They can be 2, 4, or 8 input or 2 or 4 output.
  - There is also a 4 input 2 output module for greater flexibility.
  - Both inputs and outputs can be either voltage or current.
  - The TM3T modules also allow temperature input and can be 4 or 8 input. There is also a 2 input 1 output module that can be used for temperature inputs.

- ✓ **TM3 Expert Modules**
  - There are two standard modules and four safety modules currently in the TM3 expert range.
  - The Tesys module allows connection to up to four Tesys motor starters and the transmitter receiver module allows the M221 I/O to be expanded even further by adding another 7 I/O modules.
  - Only one transmitter receiver module can be used by a single M221.
  - The safety modules offer single function or dual function for CAT3 (SIL2) or CAT4 (SIL3).

- ✓ **Total I/O**
  - Up to seven I/O modules can be added to the M221.
  - These can be TM2 or TM3 modules or a mixture of both.
  - If one of the attached modules is a TM3 expansion module then another seven modules can be added.
  - The M221 can control up to 144 I/O in total with a maximum of 42 relay outputs.

Cartridges

Physically, the cartridge is plugged on to the front of the M221 Logic Controller. A single cartridge can be added to the TM221C16X, TM221CE16X, TM221C24X and TM221CE24X controllers.



Two cartridges can be added to the TM221C40X or TM221CE40X controllers.

The cartridges are in the SoMachine Basic Library and can be added the same way as I/O modules.

Languages

Languages

IEC61131

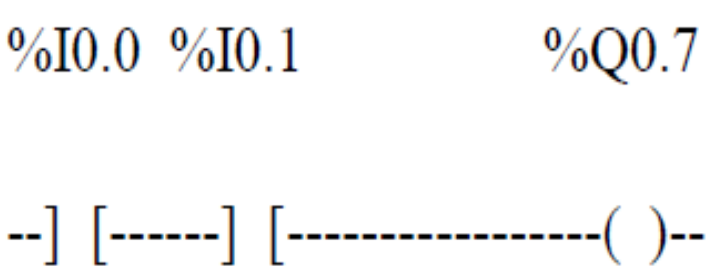
IEC61131 is the international standard for programming PLCs. Its main purpose is to define standard data types and languages. There are many data types that will be discussed later, but there are only five programming languages:

- ✓ Ladder Diagram (LD)
- ✓ Function Block Diagram (FBD)
- ✓ Structured Text (ST)
- ✓ Instruction List (IL)
- ✓ Sequential Function Chart (SFC)

Of these languages, only Ladder Diagram and Instruction List are currently supported by SoMachine Basic although other languages are planned for future releases.

Ladder

Ladder is a popular programming language as it is similar to electrical diagrams and visually, it is very easy to see what the program is doing. With the addition of in-line status display, it is also very easy to debug. It consists of a series of program lines or rungs, so called because they look like the rungs of a ladder. To the left of the rung are a set of inputs and conditions that must be solved. To the right of the rung is an object (or objects) defining what to do with the result.



Put simply, if input %I0.0 is on and input %I0.1 is on then output %Q0.7 will turn on. If either of the inputs is off then the output will also be off. Ladder does have some limitations though. It cannot perform all functions due to limitations in the programming rules and it must be converted to Instruction List before it is processed by the logic controller.

Languages

Instruction List

Instruction List is similar to computer machine code and anyone familiar with that will see many similarities. It uses a working store to load and combine values. This store is then written to an output or memory location called an accumulator.

The commands:

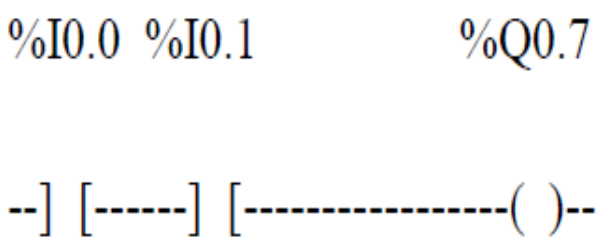
0001| LD %I0.0
0002| AND %I0.1
0003| ST %Q0.7

The three steps are:

Line 1 - Load the value of %I0.0 (0 or 1) into the accumulator
Line 2 - Perform a logical AND of the accumulator with the value of %I0.1 (0 or 1) and store the result back in the accumulator.
Line3 - Write the result (the contents of the accumulator) to output %Q0.7

This is similar to the way a calculator works. The first number is entered (or loaded) at step 1. A mathematical operator such as plus or minus is pressed and another number is entered at step 2; pressing the equals or another operator stores the result back on the display. The result is transferred from the calculator display to a piece of paper at step 3.

This can be written in ladder as:



Addressing

Addressing Format

%<Type>[<Identifier>]<Location>

An address must always begin with the % character. This tells the Logic Controller that it is an address, not some other piece of information. This is followed by one of five letters identifying the type of address:

I	The address is a physical input on either the controller or an expansion module.
K	The address is an internal memory location within the controller. The value is fixed and can NOT be changed by the program.
M	The address is an internal memory location within the controller. This value can be changed by the program.
Q	The address is a *physical output* on either the controller or an expansion module.
S	Internal system locations that are used to perform various functions and monitor the controller

none	The address contains a value that is a single bit having a value of either 0 or 1.
W	The address contains a value that is a word and has a value between 0 and 65535.
D	The address contains a value that is a double word and has a value between 0 and 4294967295.
F	The address contains a value that is in *floating point* format and has a value between 0 and 65535.

Addressing I/O Objects

❑ Memory objects

Object Type	Syntax	Example	Description
Memory bits	%Mi	%M25	Internal memory bit 25.
Memory words	%MWi	%MW15	Internal memory word 15.
Memory double words	%MDi	%MD16	Internal memory double word 16.
Memory floating points	%MFi	%MF17	Internal memory floating point 17.
Constant words	%KWi	%KW26	Constant word 26.
Constant double words	%KDi	%KD27	Internal constant double word 27.
Constant floating points	%KFi	%KF28	Internal constant floating point 28.

Addressing I/O Objects

❑ System objects

Object Type	Syntax	Example	Description
System bits	%Si	%S8	System bit 8.
System words	%SWi	%SW30	System word 30.

❑ I/O objects

Object Type	Syntax	Example	Description
Digital inputs	%Iy.z	%I0,5	Digital input 5 on the controller (embedded I/O).
Digital outputs	%Qy.z	%Q3,4	Digital output 4 on the expansion module at address 3 (expansion module I/O).
Analog inputs	%IWy.z	%IW0,1	Analog input 1 on the controller (embedded I/O).
Fast counters	%FCi	%FC2	Fast counter 2 on the controller.
High speed counters	%HSCi	%HSC1	High speed counter 1 on the controller.
Pulse	%PLSi	%PLS0	Pulse output 0 on the controller.
Pulse width modulation	%PWMi	%PWM1	Pulse width modulation output 1 on the controller.

Addressing I/O Objects

❑ **Software objects**

Object Type	Syntax	Example	Description
Timers	%TMi	%TM5	Timer instance 5.
Counters	%Ci	%C2	Counter instance 2.
Message	%MSGi	%MSG1	Program compilation status message 1.
LIFO/FIFO registers	%Ri	%R3	FIFO/LIFO registers instance 3.
Drum controllers	%DRi	%DR6	Drum controller 6 on the controller.
Shift bit registers	%SBRi	%SBR5	Shift bit register 5 on the controller.
Step counters	%SCi	%SC5	Step counter 5 on the controller.
Schedule blocks	SCH i	SCH 3	Schedule block 3 on the controller.
PID control	PID i	PID 7	PID feedback object 7 on the controller.

Maximum Number of Objects

Objects	M221 Logic Controller References			
	Modular References		Compact References	
	TM221M16R• TM221ME16R•	TM221M16T• TM221ME16T• TM221M32TK TM221ME32TK	TM221C••R TM221CE••R	TM221C••T TM221CE••T TM221C••U TM221CE••U
Memory objects				
%M(1)	512 1024	512 1024	512 1024	512 1024
%MW	8000	8000	8000	8000
%MD %MF	7999	7999	7999	7999
%KW	512	512	512	512
%KD %KF	511	511	511	511
System objects				
%S	160	160	160	160
%SW	234	234	234	234
%IWS	1 created automatically for each analog input			
%QWS	1 created automatically for each analog output			
I/O objects				
%I	8	8 (for TM221M16T• and TM221ME16T•)	9 (for TM221C16• and TM221CE16•)	9 (for TM221C16• and TM221CE16•)
		16 (for TM221M32TK and TM221ME32TK)	14 (for TM221C24• and TM221CE24•)	14 (for TM221C24• and TM221CE24•)
			24 (for TM221C40• and TM221CE40•)	24 (for TM221C40• and TM221CE40•)
(1) The value 512 is for software version < 1.3.				

Maximum Number of Objects

Objects	M221 Logic Controller References			
	Modular References		Compact References	
	TM221M16R• TM221ME16R•	TM221M16T• TM221ME16T• TM221M32TK TM221ME32TK	TM221C••R TM221CE••R	TM221C••T TM221CE••T TM221C••U TM221CE••U
%Q	8	8 (for TM221M16T• and TM221ME16T•)	7 (for TM221C16• and TM221CE16•)	7 (for TM221C16• and TM221CE16•)
		16 (for TM221M32TK and TM221ME32TK)	10 (for TM221C24• and TM221CE24•)	10 (for TM221C24• and TM221CE24•)
			16 (for TM221C40• and TM221CE40•)	16 (for TM221C40• and TM221CE40•)
%IW	2	2	2	2
%QW	0	0	**NOTE:** Analog outputs are not built in with the controller. Use cartridges TMC2AQ2V and/or TMC2AQ2C to add analog outputs to your controller configuration.	
			2 (if 1 cartridge is used) 4 (if 2 cartridges are used with TM221C40R or TM221CE40R)	2 (if 1 cartridge is used) 4 (if 2 cartridges are used with TM221C40T or TM221CE40T or TM221C••U or TM221CE••U)
%FC	4	4	4	4
%HSC	Up to 4	Up to 4	Up to 4	Up to 4
%PLS %PWM %PTO %FREQGEN	0	2	0	2
Network objects				
%QWE	20 (for TM221ME16R•)	20 (for TM221ME16T• and TM221ME32TK)	20 (for TM221CE16•)	20 (for TM221CE16•)

Maximum Number of Objects

Objects	M221 Logic Controller References			
	Modular References		Compact References	
	TM221M16R• TM221ME16R•	TM221M16T• TM221ME16T• TM221M32TK TM221ME32TK	TM221C••R TM221CE••R	TM221C••T TM221CE••T TM221C••U TM221CE••U
%IWE	20 (for TM221ME16R•)	20 (for TM221ME16T• and TM221ME32TK)	20 (for TM221CE16•)	20 (for TM221CE16•)
%QWM	20 (for TM221ME16R•)	20 (for TM221ME16T• and TM221ME32TK)	20 (for TM221CE16•)	20 (for TM221CE16•)
%IWM	20 (for TM221ME16R•)	20 (for TM221ME16T• and TM221ME32TK)	20 (for TM221CE16•)	20 (for TM221CE16•)
%IN	128	128	128	128
%QN	128	128	128	128
%IWN	128	128	128	128
%QWN	128	128	128	128
%IWNS	1 for each configured Modbus Serial IOScanner or Modbus TCP IOScanner device, plus 1 for each channel			
%QWNS	1 for each configured Modbus Serial IOScanner or Modbus TCP IOScanner device, plus 1 for each channel			
Software objects				
%TM	255	255	255	255
%C	255	255	255	255
%MSG	2	2	1 (for TM221C••R)	1 (for TM221C••T and TM221C••U)
			2 (for TM221CE••R)	2 (for TM221CE••T and TM221CE••U)
%R	4	4	4	4
%DR	8	8	8	8
%SBR	8	8	8	8
%SC	8	8	8	8

(1) The value 512 is for software version < 1.3.

Maximum Number of Objects

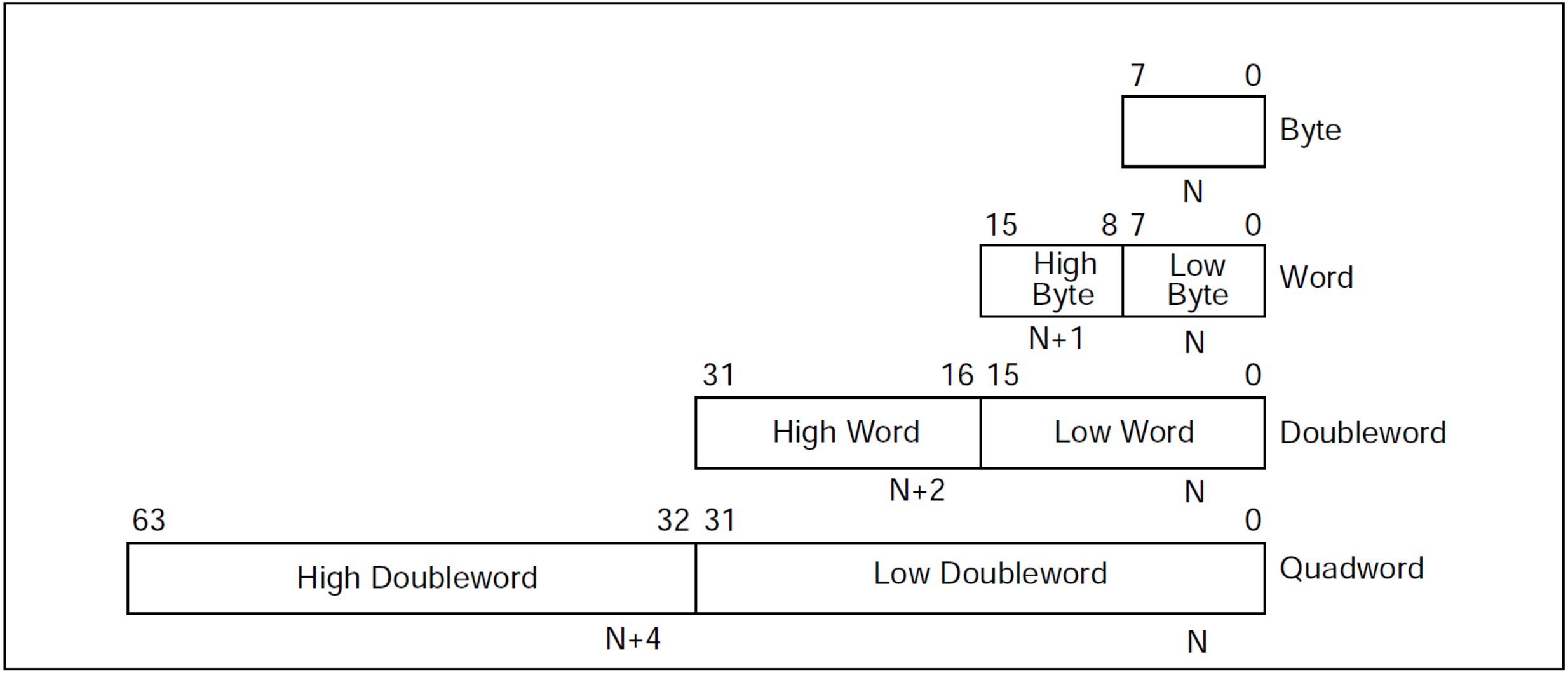
Objects	M221 Logic Controller References			
	Modular References		Compact References	
	TM221M16R• TM221ME16R•	TM221M16T• TM221ME16T• TM221M32TK TM221ME32TK	TM221C••R TM221CE••R	TM221C••T TM221CE••T TM221C••U TM221CE••U
%SCH	16	16	16	16
%RTC	2	2	2	2
PID	14	14	14	14
Drive objects				
%DRV	16	16	16	16
Communication objects				
%READ_VAR	16	16	16	16
%WRITE_VAR	16	16	16	16
%WRITE_READ_VAR	16	16	16	16
%SEND_RECV_MSG	16	16	16	16
%SEND_RECV_SMS	1	1	1	1
User-defined function and user-defined function block objects				
%RET0	1 per user-defined function			
%PARAM	5 per user-defined function and user-defined function block			
%VAR	10 per user-defined function and user-defined function block			
(1) The value 512 is for software version < 1.3.				

Maximum Number of Objects

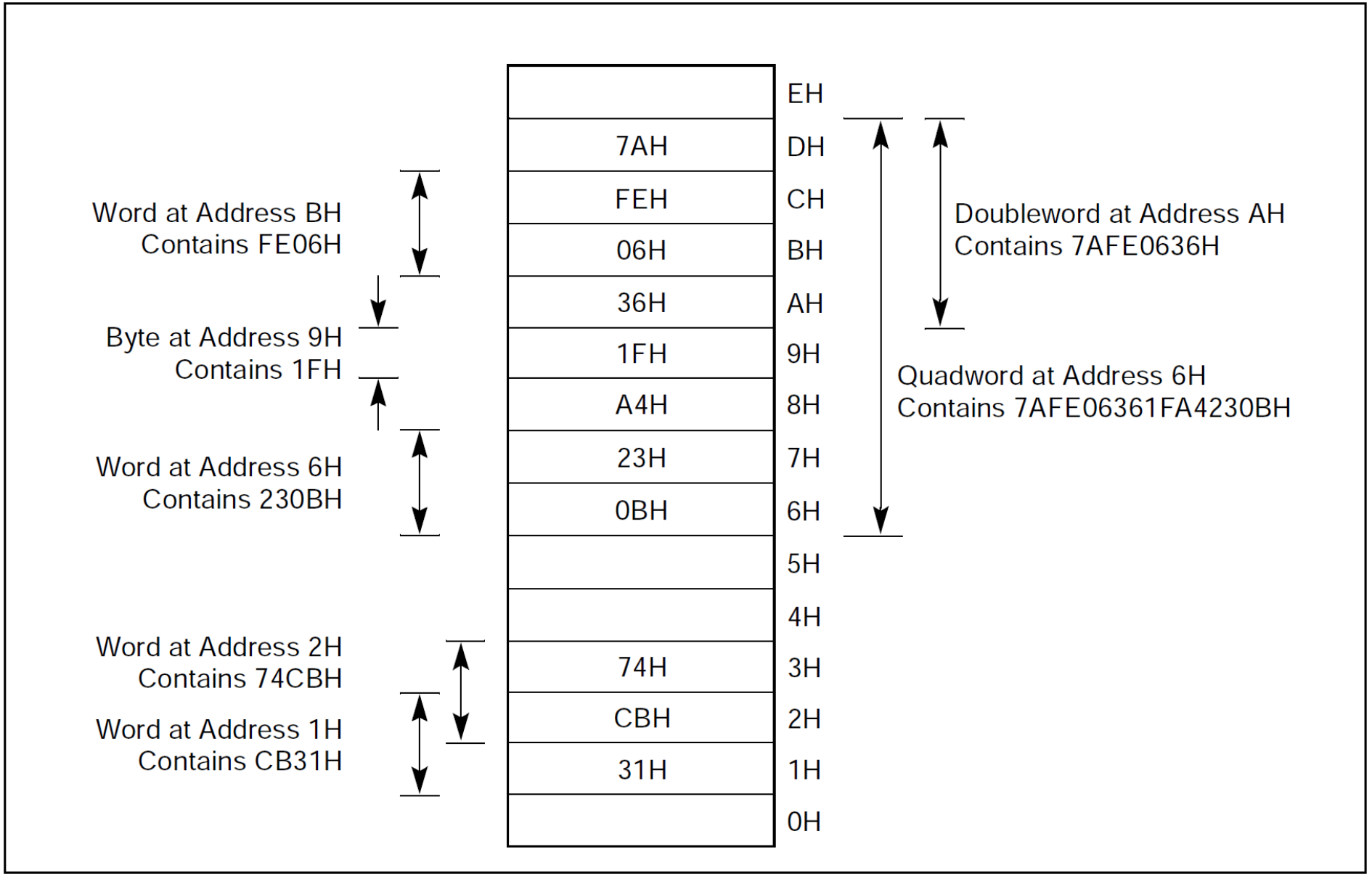
Categories/Objects	M221 Logic Controller References		
	TM221M16R• TM221ME16R• TM221C••R TM221CE••R	TM221M16T• TM221ME16T• TM221M32TK TM221ME32TK TM221C••T TM221CE••T TM221C16U TM221CE16U TM221C24U TM221CE24U	TM221C40U TM221CE40U
Motion/Single-axis			
%MC_POWER_PTO	0	86	
%MC_MOVEVEL_PTO			
%MC_MOVEREL_PTO			
%MC_MOVEABS_PTO			
%MC_HOME_PTO			
%MC_SETPOS_PTO			
%MC_STOP_PTO			
%MC_HALT_PTO			
Motion/Motion Task			
%MC_MotionTask_PTO	0	2	4
Administrative			
%MC_READACTVEL_PTO	0	40	
%MC_READACTPOS_PTO			
%MC_READSTS_PTO			
%MC_READMOTIONSTATE_PTO			
%MC_READAXISERROR_PTO			
%MC_RESET_PTO			
%MC_TOUCHPROBE_PTO			
%MC_ABORTTRIGGER_PTO			
%MC_READPAR_PTO			
%MC_WRITEPAR_PTO			

Data Types

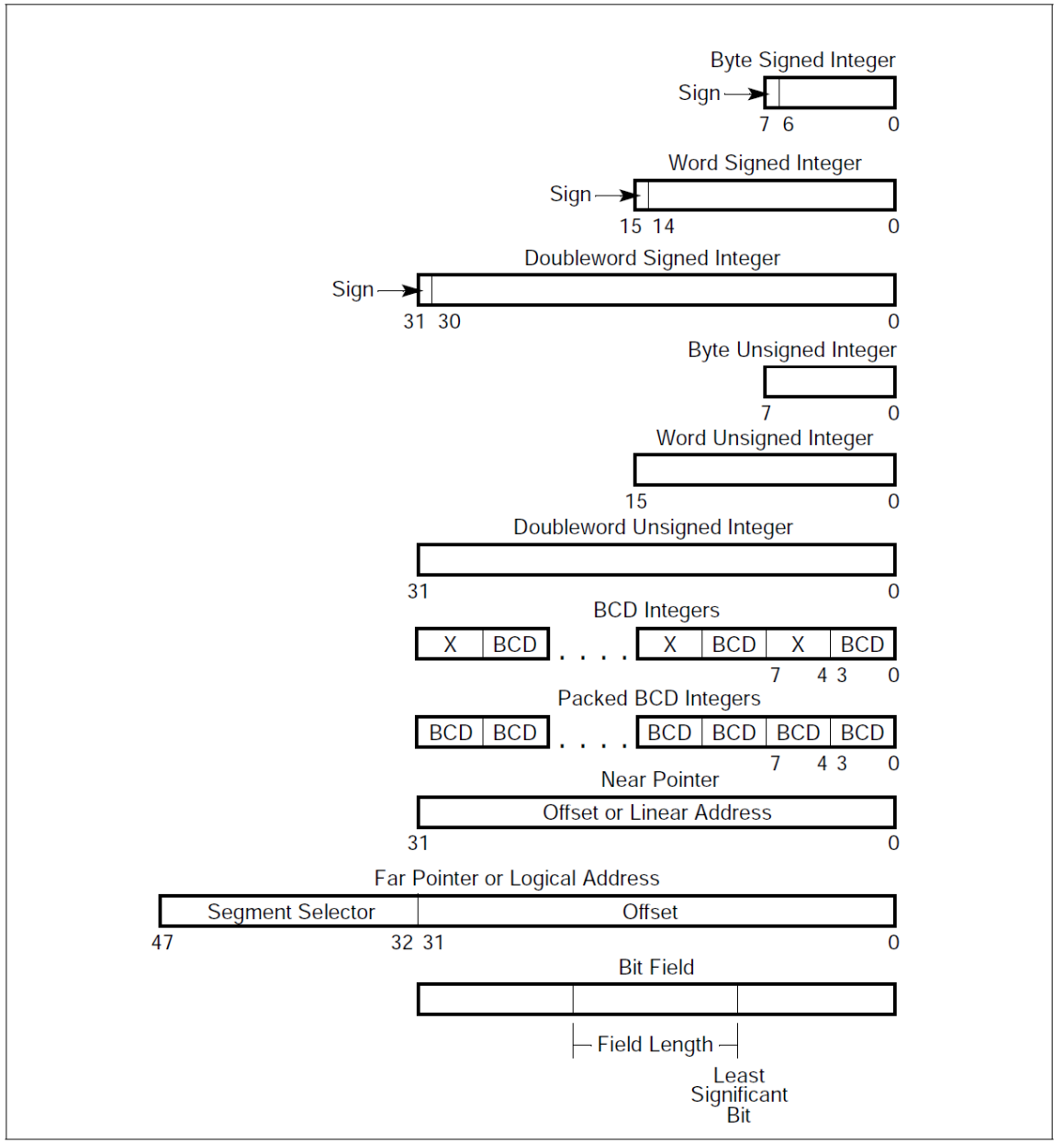
Fundamental Data Types



Bytes, Words, Doublewords and Quadwords in Memory



Numeric, Pointer, and Bit Field Data Types



Meanings of Identification Letters
(Courtesy of the Instrument Society of America)

Flow control system

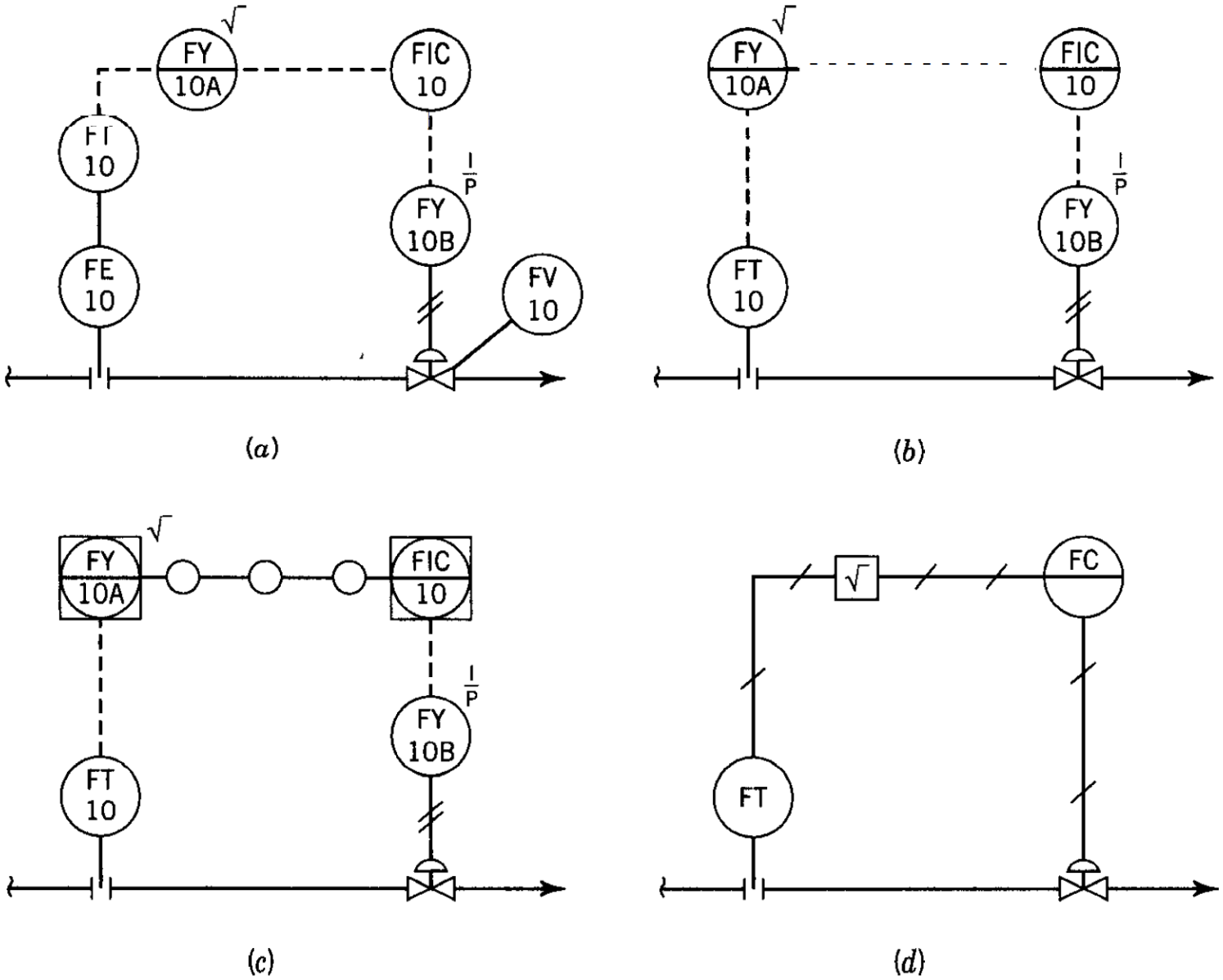


Figure A-1. Flow control system.

Meanings of Identification Letters (Courtesy of the Instrument Society of America)

Typical Tag Number

LRC 101	Instrument identification or tag number
L 101	Loop identification
101	Loop number
LRC	Functional identification
L	First letter
RC	Succeeding letters

Expanded Tag Number

20-TAH-6A	Tag number
20	Optional prefix
A	Optional suffix

Table A-l Meanings of Identification Letters (Courtesy of the Instrument Society of America)

	First Letter		Succeeding Letters		
	Measured or Initiating Variable	Modifier	Readout or Passive Function	output Function	Modifier
A	Analysis		Alarm		
B	Burner, combustion		User's choice	User's choice	User's choice
C	User's choice			Control	
D	User's choice	Differential			
E	Voltage		Sensor (primary element)		
F	Flow rate	Ratio (fraction)			
G	User's choice		Glass, viewing, device		
H	Hand				High
I	Current (electrical)		Indicate		
J	Power	scan			
K	Time, time schedule	Time rate of change		Control station	
L	Level		Light		Low

Table A-l Meanings of Identification Letters (Courtesy of the Instrument Society of America)

	First Letter		Succeeding Letters		
	Measured or Initiating Variable	Modifier	Readout or Passive Function	output Function	Modifier
N	User's choice		User's choice	User's choice	User's choice
0	User's choice		Orifice, restriction		
P	Pressure, vacuum		Point (test) connection		
Q	Quantity	Integrate, totalize			
R	Radiation		Record		
S	Speed, frequency	Safety		Switch	
T	Temperature			Transmit	
U	Multivariable		Multifunction	Multifunction	Multifunction
V	Vibration, mechanical analysis			Valve, damper, louver	
W	Weight, force		Well		
X	Unclassified	X axis	Unclassified	Unclassified	Unclassified
Y	Event, state, or presence	Y axis		Relay, compute convert	
Z	Position, dimension	Z axis		Driver, actuator, unclassified final control element	

Table A-l Meanings of Identification Letters (Courtesy of the Instrument Society of America)

Table A-1 Meanings of Identification Letters (Continued)

First Letters	Initiating or Measured Variable	Controllers				Readout Devices		Switches and Alarm Devices			Transmitters			Solenoids, Relays, Computing Devices	Primary Element	Test Point	Well or Probe	Viewing Device, Glass	Safety Device	Final Element
		Recording	Indicating	Blind	Self-Actuated Control Valves	Recording	Indicating	High	LOW	Comb.	Recording	Indicating	Blind							
A	Analysis	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW			AV
B	Burner combustion	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG		BZ
C	User's choice																			
D	User's choice																			
E	Voltage	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE					Ez
F	Flow rate	FRC	FIC	FC	FCV, FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	N	FE	FP		FG		Fv
FQ	Flow quantity	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE					FQV
FF	Flow ratio	FFRC	FFIC	FFC		FFR	FFI	FFSH	FFSL						FE					FFV
G	User's choice																			
H	Hand		HIC	HC						HS										HV
I	Current	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE					Iz
J	Power	JRC	IIC			JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE					JV
K	Time	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE					KV
L	Level	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL	LRT	LIT	LT	LY	LE		LW	LG		LV
M	User's choice																			
N	User's choice																			

Table A-l Meanings of Identification Letters (Courtesy of the Instrument Society of America)

First Letters	Initiating or Measured Variable	Controllers				Readout Devices		Switches and Alarm Devices			Transmitters			Solenoids, Relays, Computing Devices	Primary Element	Test Point	Well or Probe	Viewing Device, Glass	Safety Device	Final Element
		Recording	Indicating	Blind	Self-Actuated Control Valves	Recording	Indicating	High	LOW	Comb.	Recording	Indicating	Blind							
0	User's choice																			
P	Pressure vacuum	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	IT	PY	P E	PP			PSV, PSE	PV
PD	Pressure differential	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	P E	PP				PDV
Q	Quantity	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	Radiation	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			Rz
S	Speed frequency	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					s v
T	Temperature	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	l-r	TY	TE	TP	TW		TSE	TV
TD	Temperature differential	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	T E	TP	TW			TDV
u	Multivariable					UR	UI							UY						UV
v	Vibration machinery analysis					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	V E					VZ
W	Weight force	WRC	WIC	WC	w c v	W R	WI	WSH	WSL	WSHL	WRT	WIT	WT	W Y	W E					WZ
WD	Weight force, differential	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	W E					WDZ
X	Unclassified																			
Y	Event state presence		YIC	YC		YR	YI	YSH	YSL				YT	YY	YE					YZ
Z	Position dimension	ZRC	ZIC	zc	z c v	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	Gauging deviation	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

Table A-l Meanings of Identification Letters (Courtesy of the Instrument Society of America)

Table A-2 Function and Symbols of Computing Blocks or Software

Function	Symbol	Function	Symbol
Summation	Σ	Integral	$\int$
Multiplication	X or *	Division	÷
Square root	$\sqrt{}$	Function	f(x)
High selector	> or HS	Low selector	< or LS
High limiter	> or HL	Low limiter	< or LL
Bias	B_0	Lead-Lag	L/L

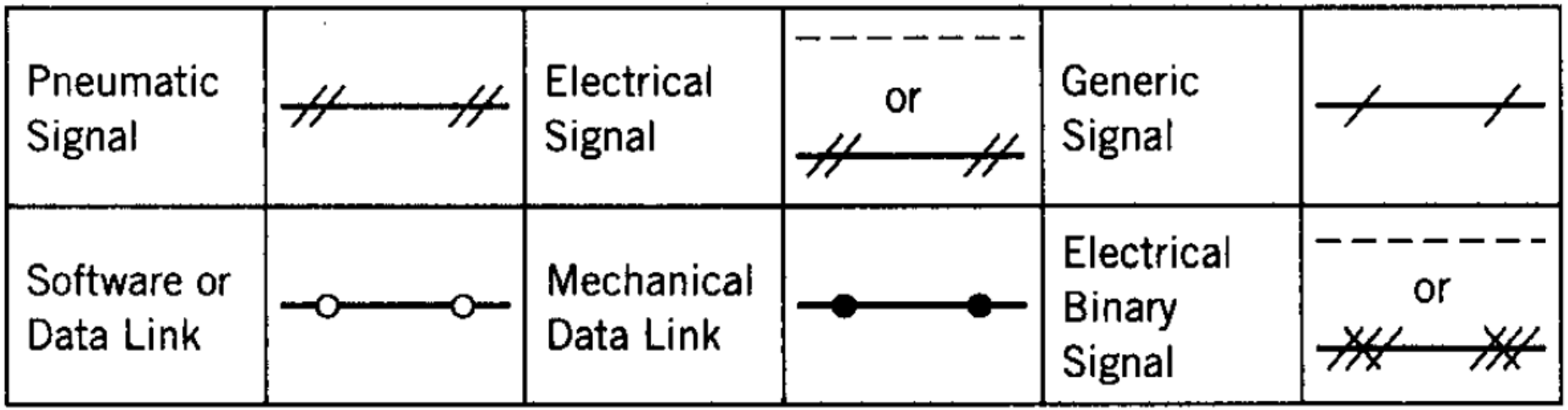


Table A-4. Instrument line (signal) symbols.

General instrument symbols.

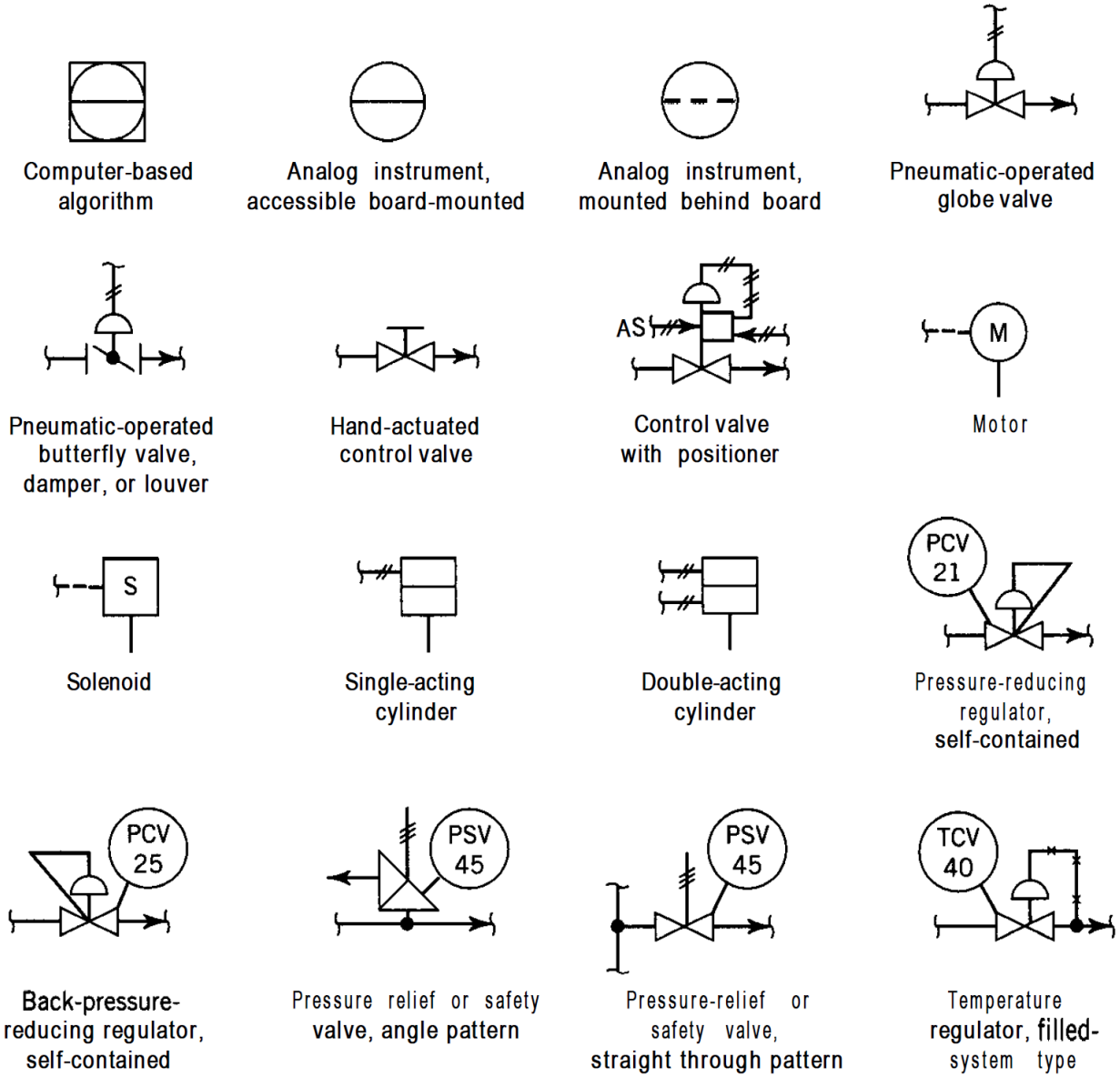
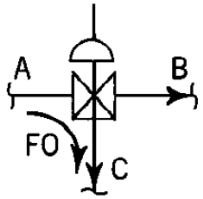
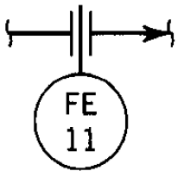


Table A-3. General instrument symbols.

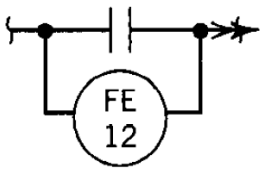
General instrument symbols



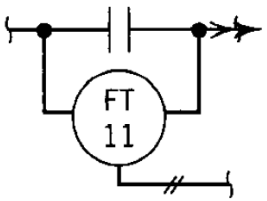
Three-way valve FO to path A-C



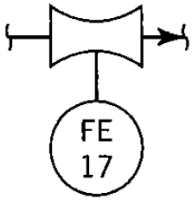
Orifice plate with flange or corner taps



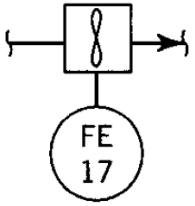
Orifice plate with vena contracta, radius, or pipe taps



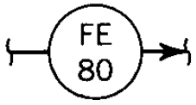
Orifice plate with vena contracta, radius, or pipe taps connected to differential pressure transmitter



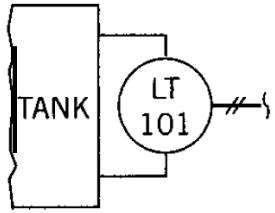
Venturi tube or flow nozzle



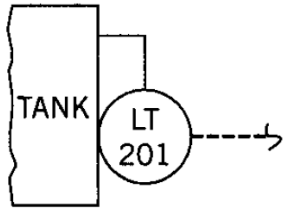
Turbine flowmeter



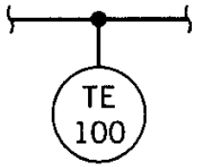
Magnetic flowmeter



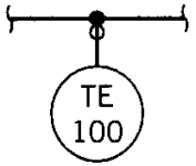
Level transmitter, external float or external type displacer element



Level transmitter, differential pressure type element



Temperature element without well



Temperature element with well

Table A-3. *(Continued)*

Flow control system

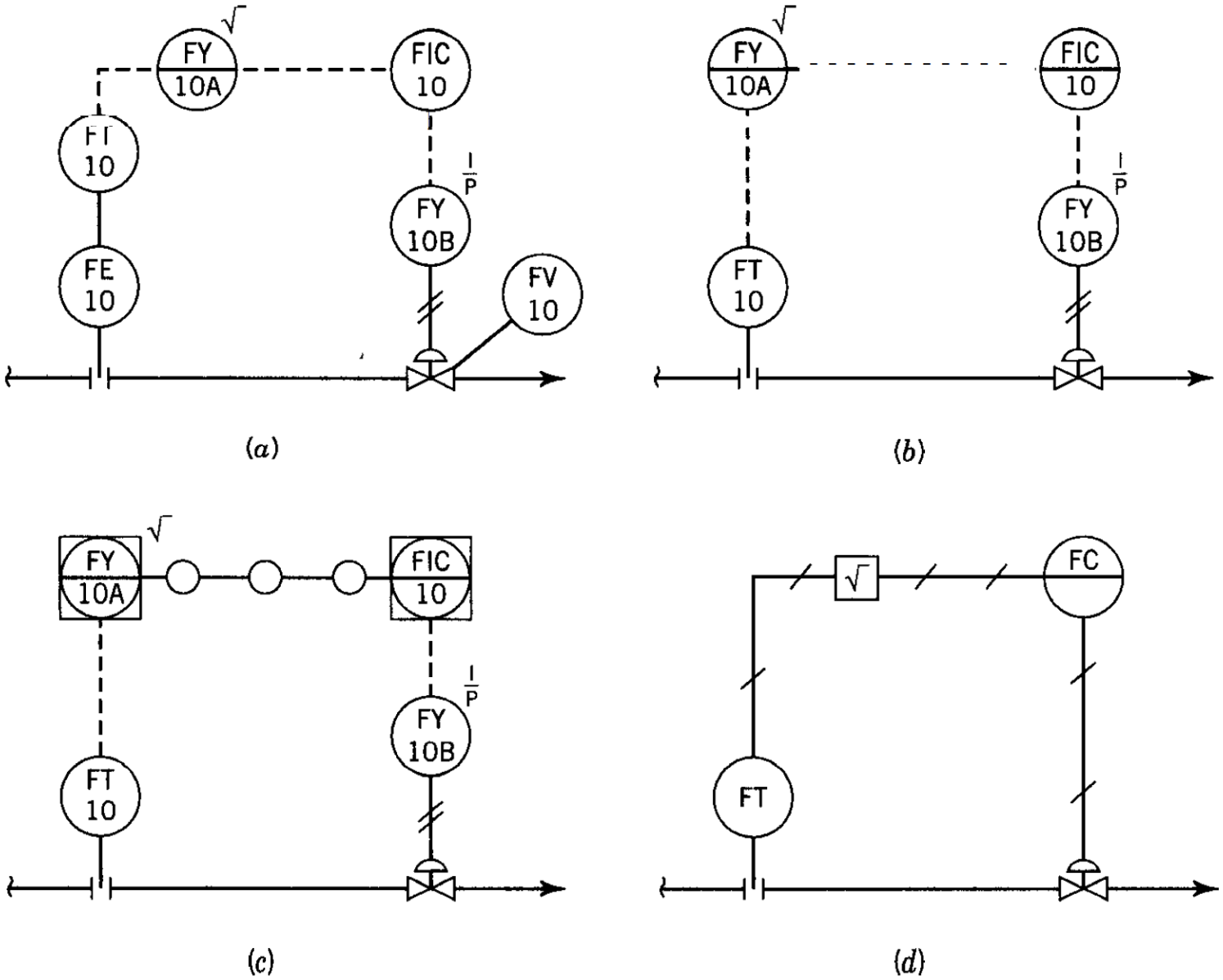
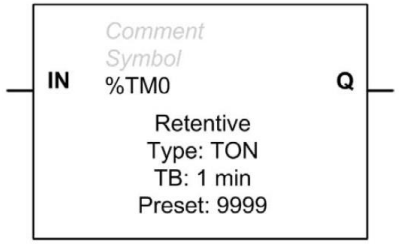


Figure A-1. Flow control system.

Timer



- ✓ Time base

  The base time unit of the timer. The smaller the Timer base unit, the greater the acuity of the Timer:

  - 1 ms (supported in %TM0...%TM5)
  - 10 ms
  - 100 ms
  - 1 sec
  - 1 min (default)

- ✓ Preset value
  - ➢ %TMi.P

    0...9999. Default value is 9999.

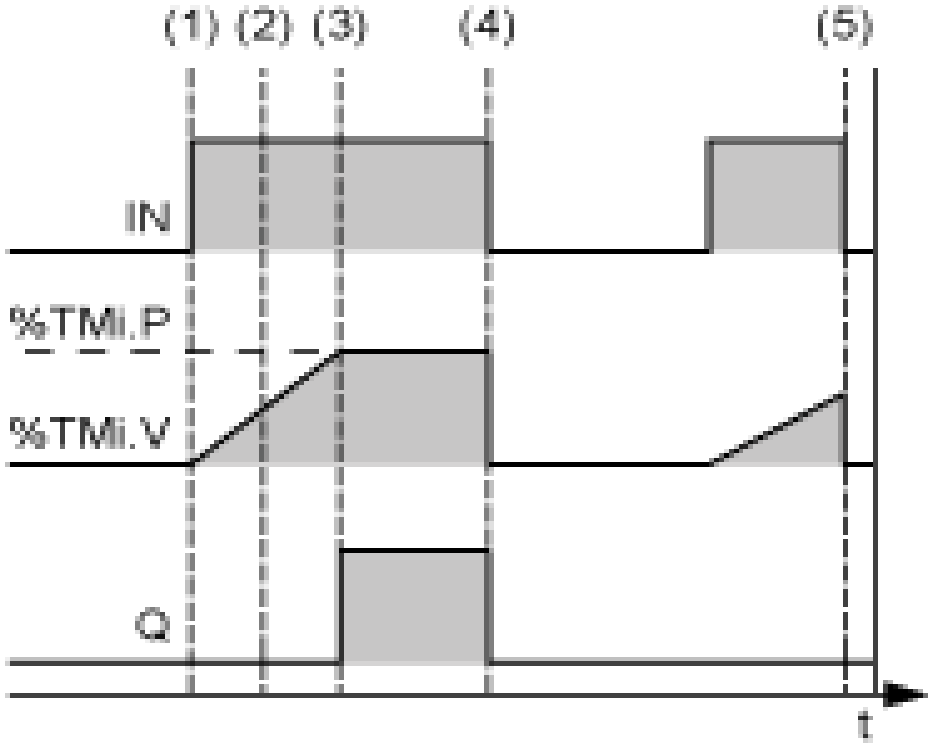
    Timer Period = Preset x Time Base
    Timer Delay = Preset x Time Base

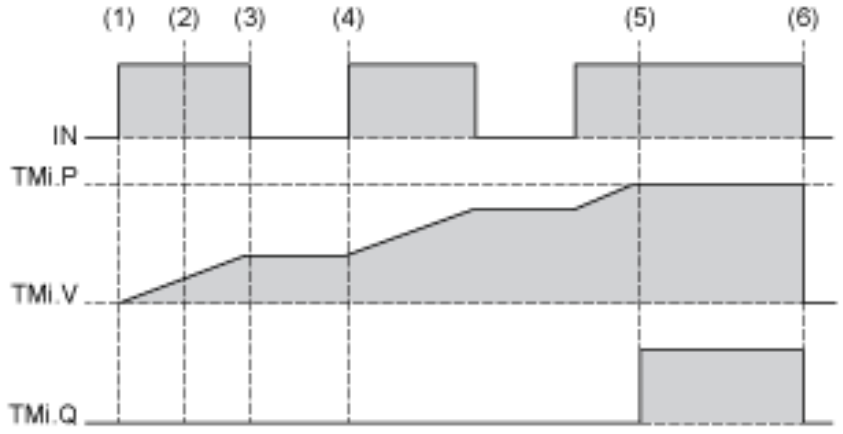
    This configured preset value can be read, tested, and modified using the associated object %TMi.P
  - ➢ %TMi.V

    Word that increments from 0 to the preset value %TMi.P when the timer is running. The value can be read and tested, but not written by the program.

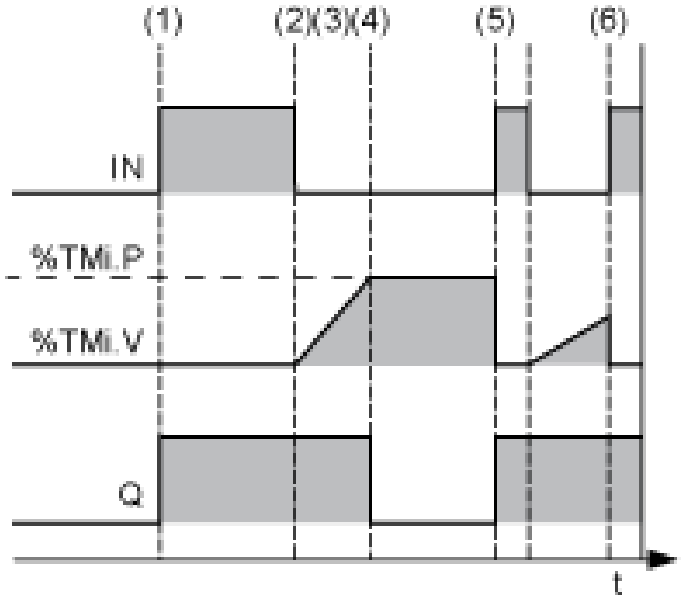
- ✓ Timer output (%TMi.Q)

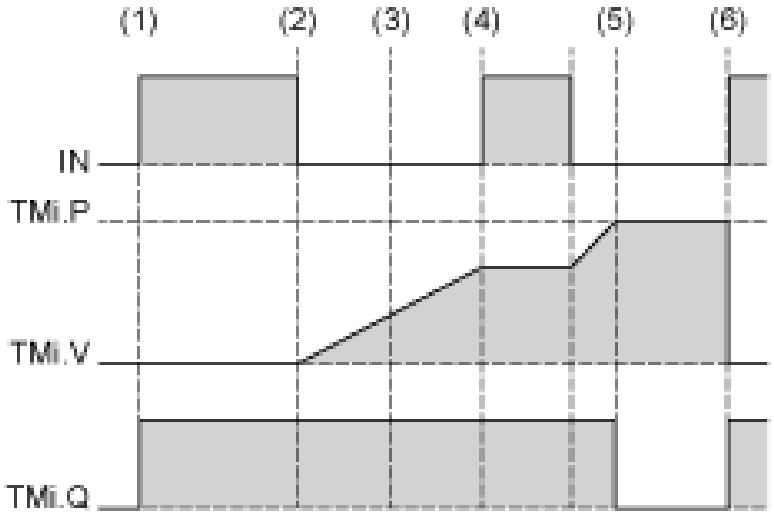
TON: On-Delay Timer





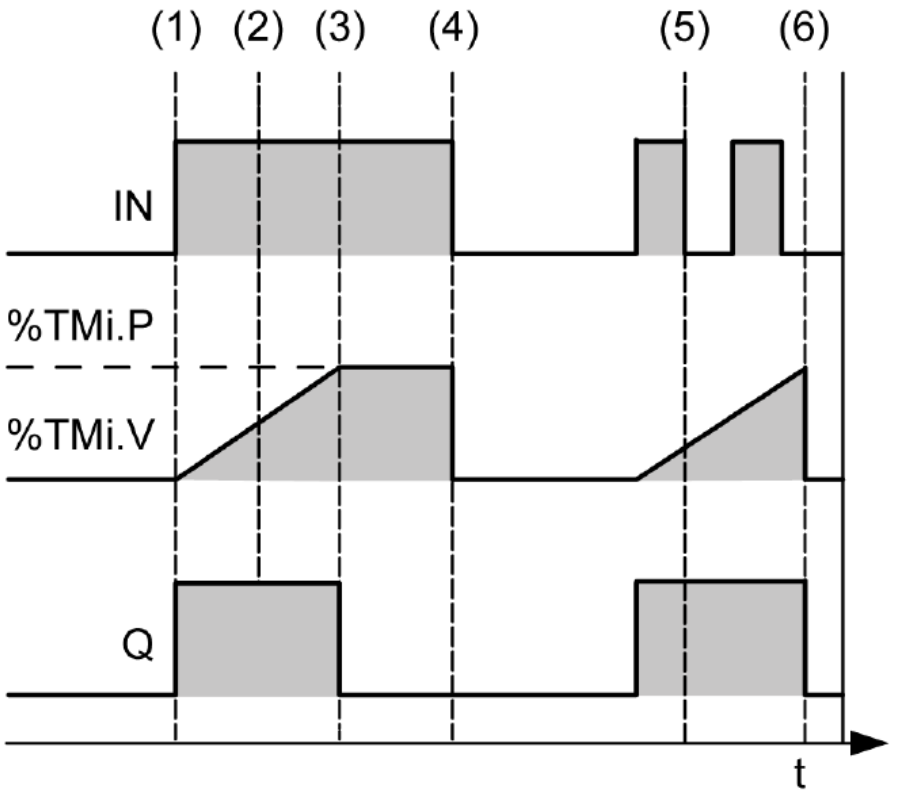
TOF: Off-Delay Timer



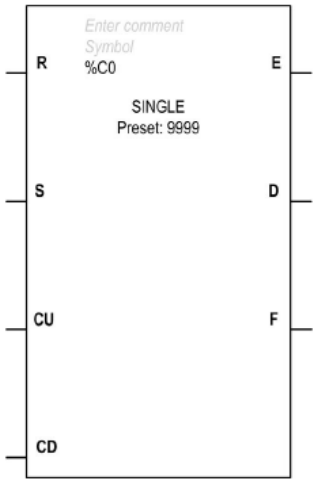


Timer

TP: Pulse Timer



Counter (%C)



❖ Inputs

Label	Description	Value
R	Reset input (or instruction)	Sets the counter (`%Ci.V`) to 0 when the reset input (**R**) is set to 1.
S	Set input (or instruction)	Sets the counter (`%Ci.V`) to the preset value (`%Ci.P`) when the set input (**S**) is set to 1.
CU	Count up	Increments the counter value (`%Ci.V`) by 1 on a rising edge at count up input (**CU**).
CD	Count down	Decrements the counter value (`%Ci.V`) by 1 on a rising edge at count down input (**CD**).

❖ Outputs

Label	Description	Value
E	Down count overflow	The associated bit `%Ci.E` (counter empty) is set to 1 when the counter reaches 0 value. In case of following decrement, the counter value passes to 9999.
D	Preset output reached	The associated bit `%Ci.D` (count done) is set to 1 when `%Ci.V = %Ci.P`.
F	Up count overflow	The associated bit `%Ci.F=1` (counter full), when `%Ci.V` changes from 9999 to 0 (set to 1 when `%Ci.V` reaches 0, and reset to 0 if the `Counter` continues to count up).

Counter (%C)

❖ Parameters

Parameter	Description	Value	Editable in online mode?
Used	Address used	If selected, this address is currently in use in a program.	No
Address	`Counter` object address	A program can contain only a limited number of counter objects. Refer to the *Programming Guide* of your controller for the maximum number of counters.	No
Symbol	Symbol	The symbol associated with this object. Refer to the SoMachine Basic Operating Guide, Defining and Using Symbols for details.	No
Preset	Preset value	Values accepted by preset value [0 – 9999]. Default value is 9999. This configured value can be read, tested, and modified using the associated object %Ci.P.	Yes
Comment	Comment	A comment can be associated with this object.	No

Counter (%C)

❖ **Objects**

Object	Description	Value
%Ci.V	Current value of the Counter	This word is incremented or decremented according to inputs (or instructions) **CU** and **CD** . Can be only read. It can be modified in an animation table.
%Ci.P	Preset value	See Parameters table . It can be modified in an animation table.
%Ci.E	Empty	See Outputs table . It can be modified in an animation table.
%Ci.D	Done	See Outputs table . It can be modified in an animation table.
%Ci.F	Full	See Outputs table . It can be modified in an animation table.